MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017 / 2018

ECE3296 – DIGITAL IMAGE AND VIDEO PROCESSING
(ME)

11 OCTOBER 2017
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **FIVE** printed pages with **FOUR** questions.

2. Answer **ALL** questions.

3. Write your answers in the Answer Booklet.

Question 1

(a) Explain the terms 'subjective brightness' and 'brightness adaptation' in the context of human visual system.

[4 marks]

(b) Distinguish between illumination and reflectance in the context of image formation model.

[4 marks]

(c) Describe, with the aid of 7x7 image matrix diagrams, the following distance metrics:

   (i) Euclidean distance

[3 marks]

   (ii) City-block distance

[3 marks]

   (iii) Chess-board distance

[3 marks]

(d) For Figure Q1A, explain what is happening in images (a) and (b) in terms of Weber's ratio and levels of illumination.
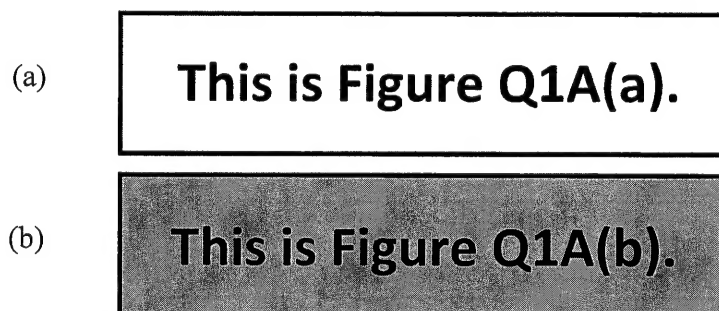
[3 marks]

(a)   This is Figure Q1A(a).

(b)   This is Figure Q1A(b).

Figure Q1A

(e) Figure Q1B (a) shows an image sampled at 256 × 256 pixels with 8-bit gray-level quantization, while Figure Q1B (b) and (c) shows two lower quality versions of the image.

   (i) Determine the size of bits required to store the image in Figure Q1B (a).

[2 marks]

   (ii) Suggest the sampling and quantization rates for the images in Figure 1.3(b) and (c) respectively.
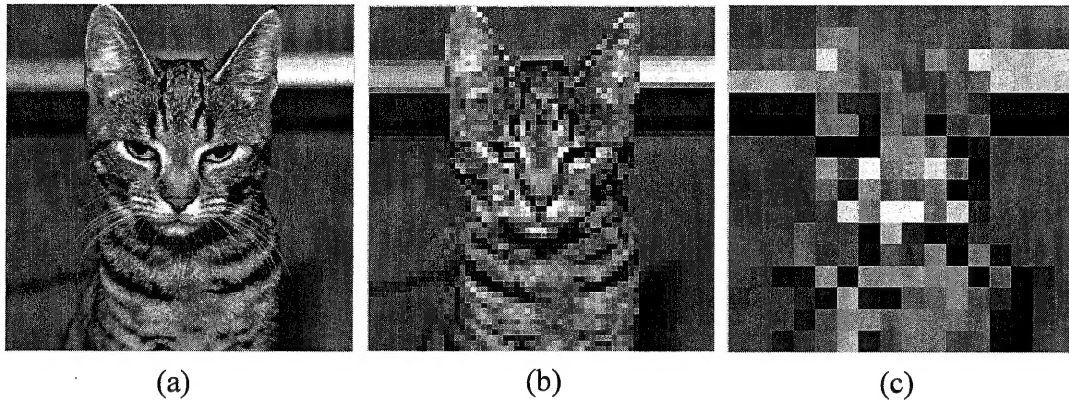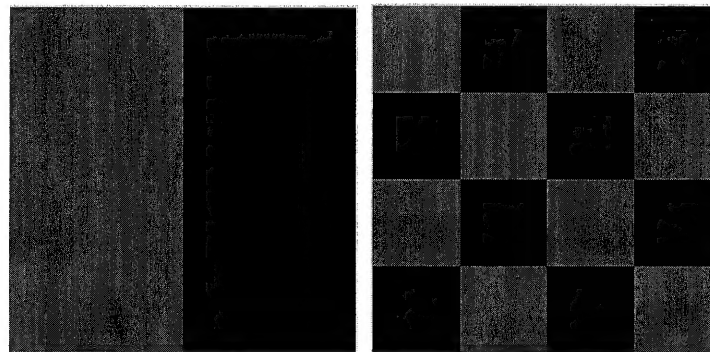
[3 marks]

Continued ....

(a)   (b)   (c)

Figure Q1B

Question 2

(a) Distinguish between image enhancement and image restoration. Suggest one suitable application for each of them.

[6 marks]

(b)

(a) Image A   (b) Image B

Figure Q2

Figure Q2 shows two texture images. Both images have size of 4 x 4, with black and red pixels.

(i) Images A and B are quite different but their histograms are indentical. Explain this phenomenon.

[3 marks]

(ii) Perform image blurring with 3 x 3 averaging mask to both images. You may consider the red (R) channel only in your calculation.

[6 marks]

(iii) Analyse the resultant histograms of the blurred images. Would they still be the same? Explain your answer.

[4 marks]

Continued ....

(c)   Briefly explain on the Image Negative and the Log transformations, including their benefits in image enhancement applications.

[6 marks]

Question 3

(a)   In the context of image segmentation, briefly describe the 'edge linking' method. What are the two properties used for establishing similarity of edge pixels?

[5 marks]

(b)   Figure Q3A shows a 7×7 image to be segmented using the region growing algorithm. Determine the segmentation results for 4-connectivity and 8-connectivity approaches.

10	10	10	10	10	10	10
10	10	10	69	70	10	10
59	10	60	64	59	56	60
10	59	10	60	70	10	62
10	60	59	65	67	10	65
10	10	10	10	10	10	10
10	10	10	10	10	10	10

Figure Q3A

Hint: The seed of the object is the center of the image. Region is grown when the differences between two pixel values is less than or equal to 5.

[8 marks]

(c)   Figure Q3B shows 4 different classes of objects, with 5 different samples per object (one object occupy one row of images). As a computer programmer, you are required to design and develop a program that can classify the 20 images into the 4 different classes. Include your hypotheses and description of the methods that can be used for each step in the system.
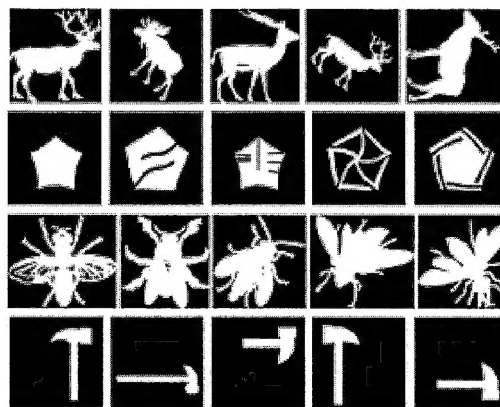

Figure Q3B

[12 marks]

Continued ....

Question 4

(a) Consider the following two video scenes:

  i) the scene consists of vertical bars moving horizontally
  ii) the scene consists of horizontal bars (closely spaced) moving horizontally

  Suggest which scanning method (progressive or interlaced) is better at capturing each scene. Justify your answer.

[6 marks]

(b) A video captured using a video camera is to be transmitted over a wireless network to a mobile device. The captured video has the following parameters:

  * 720 pixels/line & 576 lines for luminance
  * 360 pixels/line & 288 lines for chrominance
  * 60 frames/s and 24 bits/pixel

  (i)   Determine the data rate to transmit this video sequence.

[4 marks]

  (ii) Propose and explain down-conversion method to reduce the data rate found in Question 5(b)(i).

[6 marks]

(c) In an intelligent video retrieval system, the moving object in the scene is to be indexed so that the related frames can be easily retrieved. This involves video segmentation. Use pseudo code to design a simple moving object detection algorithm based on frame differencing method. Mention the image processing technique that is used in your algorithm and use the following notation:

  (i) $I(x,y,t)$ represent pixel value at coordinate (x,y) and presented at time t.

  (ii) Foreground mask $M(x,y,t) = 1$ if pixel (x,y,t) belongs to a moving object.

  (iii)Foreground mask $M(x,y,t) = 0$ if pixel (x,y,t) does not belong to a moving object.

[6 marks]

(d) Identify and analyze the three weaknesses found in the algorithm presented in Question 4(c).

[3 marks]

End of paper